

NEW SPECIES OF GRASS FEEDING HECALINE LEAFHOPPER GENERA *GLOSSOCRATUS* AND *HECALUS* (HEMIPTERA: CICADELLIDAE) FROM INDIA¹

PRATAP CHANDRA DASH² AND C.A. VIRAKTAMATH³

(With forty-one text-figures)

Two new species of *Glossocratus* Fieber namely, *G. indicus* sp. nov. (from Karnataka: Bangalore, Meghalaya: Shillong) and *G. ramakrishnai* (from Karnataka: Bangalore) and five new species of *Hecalus* Stål namely, *H. bifidus* sp. nov. (from Karnataka: Dharwar, Gadag), *H. caudatus* sp. nov. (from Karnataka: Bangalore), *H. compressus* sp. nov. (from Karnataka: Bangalore, Halebid-Belur), *H. dentatus* sp. nov. (from Karnataka: Jog falls, Kogar, Koppa) and *H. tuberculatus* sp. nov. (from Karnataka: Bangalore) are described and illustrated. Their relationship with other species of the genera are discussed. *Hecalus gressitti* Morrison is recorded from India. New locality records for other species of *Hecalus* are given. A revised key to Indian species of *Glossocratus* and *Hecalus* is also included.

INTRODUCTION

The tribe Hecalini, a small tribe of the subfamily Deltocephalinae, includes depressed grass feeding leafhoppers distributed in all the zoogeographical areas of the world. The Oriental Hecalini were revised by Morrison (1973) in which he dealt with five species of *Glossocratus* Fieber and ten species of *Hecalus* Stål from India. Linnavuori (1975) revised the Hecalini of the Afrotropical region. Rao and Ramakrishnan (1990) reviewed the Indian species of *Hecalus* and described three new species in addition to recording *H. prasinus* (Matsumura) from Delhi, bringing the total number of Indian species of *Hecalus* to 14.

During our studies on the Indian Deltocephalinae, we discovered *Hecalus gressitti* Morrison and new species of *Glossocratus* and *Hecalus* which are described here.

The following abbreviations are used for the repositories of the types of new taxa and other material dealt with in this study:

NHM - The Natural History Museum, London, U.K.

NPC - The National Pusa Collection, Indian Agricultural Research Institute, New Delhi, India.

UAS - The University of Agricultural Sciences, Bangalore, India.

ZSI - The Zoological Survey of India, Calcutta, India.

Key to distinguish the genera *Glossocratus* and *Hecalus*.

1. Gena very broad, lateral margin with a deep rectangular notch below eye (Fig. 1); pronotum densely granulose; hind femoral spinulation 2+2+1+1+1; female ovipositor not exceeding pygofer; male pygofer with 2-3 rows of short, stout setae on posterior margin (Fig. 2). . . . *Glossocratus* Fieber

- Gena narrower, lateral margin moderately notched below eye; pronotum transversely rugose atleast in posterior half; hind femoral spinulation 2+2+1; female ovipositor exceeding pygofer (Fig. 18); male pygofer without short, stout setae on posterior margin (Fig. 20). . . . *Hecalus* Stål

Genus *Glossocratus* Fieber

KEY TO INDIAN SPECIES OF *Glossocratus* (for males only)

1. Aedeagus with one pair of terminal processes (Fig. 7) *G. indicus* sp. nov.
- Aedeagus with two pairs of terminal processes ... 2
2. Dorsal pair of aedeagal processes twice as long as ventral pair; shaft in ventral view uniform in thickness throughout *G. breviceps* Morrison
- Both pairs of aedeagal terminal processes of equal length (Figs. 12, 13); shaft in ventral view broadened subapically (Fig. 12). *G. ramakrishnai* sp. nov.

¹Accepted November, 1996

²Present address: Department of Entomology, Orissa University of Agriculture and Technology, Bhubaneswar 751 003, Orissa, India.

³Department of Entomology, University of Agricultural Sciences, GKVK, Bangalore 560 065, India.

1. *Glossocratus indicus* sp. nov. (Fig. 1-7)*Glossocratus* sp. Rao, 1990: 53-55

Ochraceous vertex, pronotum and scutellum with scattered dark brown spots. Vertex with callosities on either side of median line near posterior margin dark brown; a median triangular spot on posterior margin black. Scutellum with callosities anterior to transverse sulcus, a spot at mid point on lateral margin black. Forewing with a black spot at base and another at base of appendix, veins with a series of dark brown spots on either side. Frontoclypeus with brown spots arranged in oblique rows; transclypeal sulcus laterally brownish, anterior margin of clypellus black but interrupted in middle. Black fascia on pro and mesopleura and a black spot on metapleura. A subapical and apical spot on fore tibia, apical spot on mid tibia, large apical spot on hind tibia blackish brown; hind tibiae streaked with dark brown on dorsal surface, bases of setae dark brown.

Head anteriorly foliaceous. Vertex rather triangular, proportions of interocular distance to length 61:39. Ocelli close to eyes. Face (Fig. 1, anatomically includes part of frons, clypeus, clypellus, lora and genae which together form ventral part of head in leafhoppers) wider than long. Pronotum as long as vertex, 2.45 times as wide as long, hind margin slightly emarginate in middle. Scutellum longer than pronotum.

Male genitalia: Pygofer heavily setose in apical half. Valve broadly triangular. Subgenital plate broad at base, triangular, few marginal setae. Style with finger-like apophysis, preapical lobe well developed. Connective Y-shaped, arms slightly longer than stem. Aedeagus with a short dorsal apodeme, base bulbous, shaft with two dorsal rather triangular lamellate subapical processes; a pair of apical processes, laterally curved, each with a prominence at basal 0.33, gonopore apical.

Measurements: Male 7.5 and 8.0 mm long, 2.22 and 2.25 mm wide across eyes.

Material examined: Holotype male, INDIA: Karnataka: Bangalore, 916 m, at light, 23.iv.1981, Coll. C.A. Viraktamath, (UAS). Paratype: 1 male, INDIA: Karnataka: Bangalore, 916 m, ex. cowpea,

27.iii.1977, Coll. Ramakrishna, (NHM). Other material: 1 male, INDIA: Meghalaya: Shillong, 3. xi. 1976, Coll. K.R. Rao, (ZSI).

Remarks: *G. indicus* can be identified easily by the single pair of terminal aedeagal processes. It is related to *G. orientalis* (Ishihara) and *G. platalea* (Noualhier) in that all the three share the triangular subapical lamellate process to aedeagal shaft. There is considerable variation in the shape of the vertex in the three specimens.

2. *Glossocratus ramakrishnai* sp. nov.

(Figs. 8-13)

Ochraceous head, pronotum, scutellum with fine dark brown spots, those on vertex and pronotum running into longitudinal stripes. Vertex in one of the specimens with prominent blackish apical spots, one on either side of median line which is faint but discernible in the other, callosities brownish in the paler specimen, black in the darker specimen, basal lateral spots on scutellum and apex of scutellum black or fuscous, a submarginal stripe below lateral carina of pronotum piceous, pro and mesothoracic pleura with black stripe. Femora spotted with dark brown, bases of setae on legs dark brown

Head anteriorly foliaceous. Vertex triangular, proportion of interocular distance to length 55:41. Ocelli placed a distance equal to their own diameter from adjacent eye. Face longer than wide. Pronotum 2.34 times as wide as long, about as long as or slightly shorter than vertex, hind margin slightly emarginate. Scutellum as long as or slightly longer than pronotum.

Male genitalia: Similar to *G. indicus*. Aedeagus with well developed dorsal apodeme, shaft tubular, broadest subapically, with two pairs of short processes of equal length, apex of shaft with a V-shaped notch, gonopore apical.

Measurements: Male 6.7 and 7.5 mm long, 2.10 and 2.18 mm wide across eyes.

Material examined: Holotype male, INDIA: Karnataka: Bangalore, 916 m, GKVK, 3.vi.1982, Coll. H.V.A. Murthy, (UAS). Paratypes: 1 male, data as for holotype 23.ix.1992, Coll. P.C. Dash, (NHM).

Remarks: *G. ramakrishnai* can be separated from other species of the genus by the position of ocelli in male which are placed slightly away from the adjacent eyes as in females. The aedeagal processes are unusually short and the apex of shaft is notched. These characters show its distant phylogenetic relationship to other species of the genus.

Genus *Hecalus* Stal

The new species described here have male pygofer heavily setose in apical half, valve triangular and subgenital plates flat, caudally tapering, with a few (3-5) submarginal setae. The style has well developed anteapical lobe, apophysis is laterally curved, its surface finely sculptured. Connective is somewhat Y-shaped, with a broad stem. Aedeagus invariably has dorsal marginal foliaceous lateral extension varying in width.

KEY TO INDIAN SPECIES OF *Hecalus* (only males)

1. Thorax and face brown to piceous 2
- Thorax and face green to yellowish green. 3
2. Male 4.5 mm long, aedeagal shaft without prominent mid-dorsal lateral flares (Fig. 41)
..... *H. dentatus* sp. nov.
- Male 5.8 mm long, aedeagal shaft with prominent mid-dorsal lateral flares *H. lutescens* (Distant)
3. Concentric parabolic orange fasciae on head and pronotum *H. arcuatus* (Motschulsky)
- Colouration not as above 4
4. One pair of aedeagal processes, not branched or forked 5
- Two pairs of aedeagal processes or one pair of branched or forked processes 14
5. Longitudinal orange lines on head, pronotum and scutellum, forewings brown in apical 0.33 with white spots in apical and anteapical cells
..... *H. porrectus* (Walker)
- Without longitudinal orange lines (may have brown lines as in *H. umballaensis*); head, pronotum, scutellum and forewings entirely green to yellowish green 6
6. Apical process of aedeagus rather leaf-like, with serrated dorsal margin 7
- Apical process of aedeagus narrower, not leaf-like, with smooth dorsal margin 10

7. Vertex, pronotum and scutellum with longitudinal brown lines; aedeagal shaft of uniform width throughout length in lateral view
..... *H. umballaensis* (Distant)
- Vertex, pronotum and scutellum uniformly green or yellowish green, without longitudinal brown lines; aedeagal shaft varying in width in lateral aspect .. 8
8. Apical aedeagal processes directed caudally (Figs. 23, 24) *H. caudatus* sp. nov.
- Apical aedeagal processes directed antero-laterally (Figs. 34-36) 9
9. Aedeagal shaft constricted medially
..... *H. morrisoni* Rao and Ramakrishnan
- Aedeagal shaft broadened in apical 0.2 then slightly narrowed and rounded (Figs. 34, 35)
..... *H. compressus* sp. nov.
10. Aedeagal shaft expanding distally into a diamond-shaped flare below apical processes 11
- Aedeagus without such a flare 12
11. Aedeagal shaft ventrally keeled, laterally compressed, constricted medially without lateral lamellate processes. *H. wallengreni* (Stål)
- Aedeagal shaft dorsally grooved, with lateral lamellate processes, uniformly distally narrowed
..... *H. pusae* Rao and Ramakrishnan
12. Aedeagal shaft strongly narrowed caudally
..... *H. ghaurii* Rao and Ramakrishnan
- Aedeagal shaft not narrowed caudally 13
13. Aedeagal shaft dorsally grooved with a subapical tooth on each edge subapically (Figs. 29, 30)
..... *H. tuberculatus* sp. nov.
- Aedeagal shaft without subapical tooth on lateral margin dorsally, without dorsal groove
..... *H. prasinus* (Matsumura)
14. Aedeagal shaft strongly grooved laterally in distal 0.33, with one pair of forked processes (Figs. 15-17); without orange lines on head
..... *H. bifidus* sp. nov.
- Aedeagal shaft without grooves; with two pairs of processes; head with orange lines 15
15. Apical pair of aedeagal processes 0.2 as long as other pair *H. gressitti* (Linnavuori)
- Apical pair of aedeagal processes as long as the other pair. *H. apicalis* (Matsumura)

3. *Hecalus arcuatus* (Motschulsky)

Platymetopius arcuatus (Motschulsky, 1859: 115
Tetigonia (Diedrocephala) kalidasa Kirkaldy,
1900: 294

Parabolocratus centralis Matsumura, 1912: 288

Parabolocratus citrinus Evans, 1941: 36

Varta moshiensis Rao, 1973: 96, synonymized by Rao, 1989: 66. *Hecalus arcuatus*: Morrison, 1973: 426; Rao, 1989: 66

Material examined: Several specimens from Karnataka: Bangalore, Bidar, Chincholi, Dharwar, Gadag, Gulbarga, Hagari, Halebid-Belur, Kemmannagundi (1100 m), Nandi Hills (1467 m), Raichur, Yalburga; Maharashtra: Dhond; Mizoram: Aizawl, Lunglei; Tamil Nadu: Barliar (860 m).

Remarks: A widely distributed species with very characteristic colouration.

4. *Hecalus bifidus* sp. nov.

(Figs. 14-17)

Yellowish green. Forewing yellowish green with a black spot at apex of clavus. Anterior rim of head margined both above and below with brown.

Vertex subtriangularly produced, proportion of interocular width to length 36:24. Pronotum longer than vertex, 2.07 times as wide as long.

Male genitalia: Aedeagus with well developed dorsal apodeme, shaft laterally grooved in apical 0.33 with a terminal pair of forked processes.

Measurements: Male 4.8 and 5.2 mm long, 1.43 mm wide across eyes.

Material examined: Holotype male, INDIA: Karnataka: Dharwar, xi. 1969, Light trap, Viraktamath, (UAS). Paratype: 1 male, INDIA: Karnataka: Gadag, 21.ii.1978, C.A. Viraktamath, (NHM).

Remarks: This species is closely related to *H. furcatus* Morrison from China in having grooved aedeagal shaft and forked apical process of the aedeagus. It can, however, be distinguished from *H. furcatus* in the aedeagal shaft being of uniform width and aedeagal process larger and unequal in length.

5. *Hecalus apicalis* (Matsumura)

Parabolocratus apicalis Matsumura, 1912: 287

Hecalus apicalis: Morrison, 1973: 424

Material examined: Several specimens from Karnataka: Bangalore, Chincholi, Dharwar, Gadag, Jog Falls, Kemmannagundi (1100 m), Mudigere, Raichur; Tamil Nadu: Nilgiri Hills; Mizoram: Aizawl, Lunglei.

Remarks: It is a widely distributed species in the Oriental region to be recognised by the longitudinal orange lines on head and pronotum, and in males apical 0.33 of forewings dark brown to black with white spots. *H. gressitti* and *H. porrectus* also have similar colouration but can be distinguished by the aedeagal characters given in the key.

6. *Hecalus gressitti* (Linnavuori)

Parabolocratus gressitti Linnavuori, 1960: 272

Hecalus gressitti: Morrison, 1973: 423

Material examined: INDIA: 2 males, 4 females, West Bengal: Calcutta, 17.iv.1975, Coll. C.A. Viraktamath, 3 males, 1 female, Mizoram: Aizawl, 18.x.1981, Coll. C.S. Wesley, (UAS).

Remarks: Coloration similar to that of *H. apicalis* but differs in possessing shorter apical processes of aedeagal shaft which are 0.2 times as long as the subapical pair. This is the first record of the species from India. It was earlier known from W. Caroline Islands, the Philippines, Amboina, Singapore, Penang and Laos (Morrison, 1973).

7. *Hecalus porrectus* (Walker)

Acocephalus porrectus Walker, 1858: 232

Platymetopius lineolatus Motschulsky, 1859: 114

Hecalus kirschbaumi Stål, 1870: 737

Thomsoniella viridis Distant, 1908: 280

Parabolocratus rusticus Distant, 1918: 31, nom nov. pro *Thomsoniella viridis* not Uhler, 1877

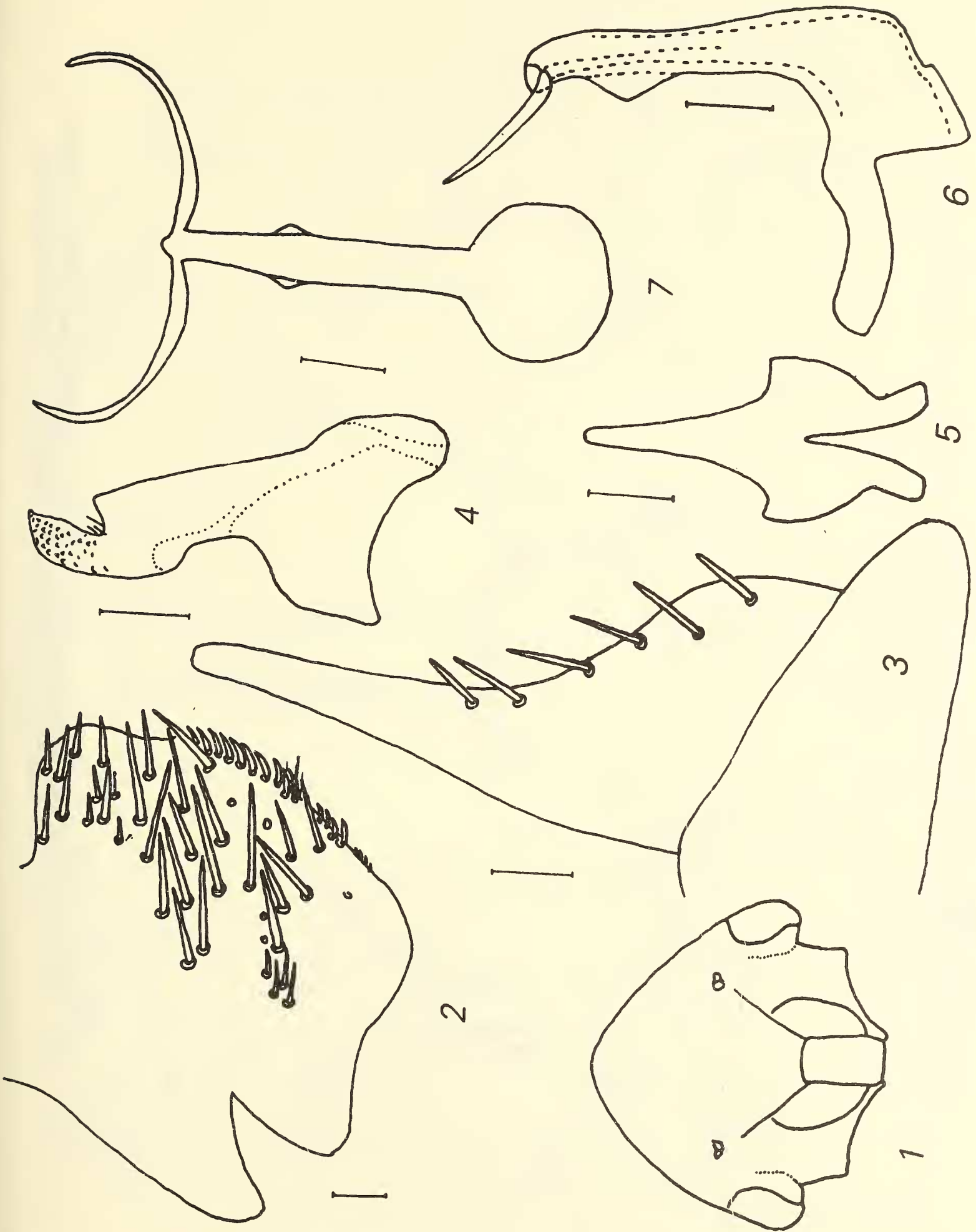
Thomsoniella albomaculata Distant, 1908: 280

Parabolocratus merinoi Capco, 1959: 333

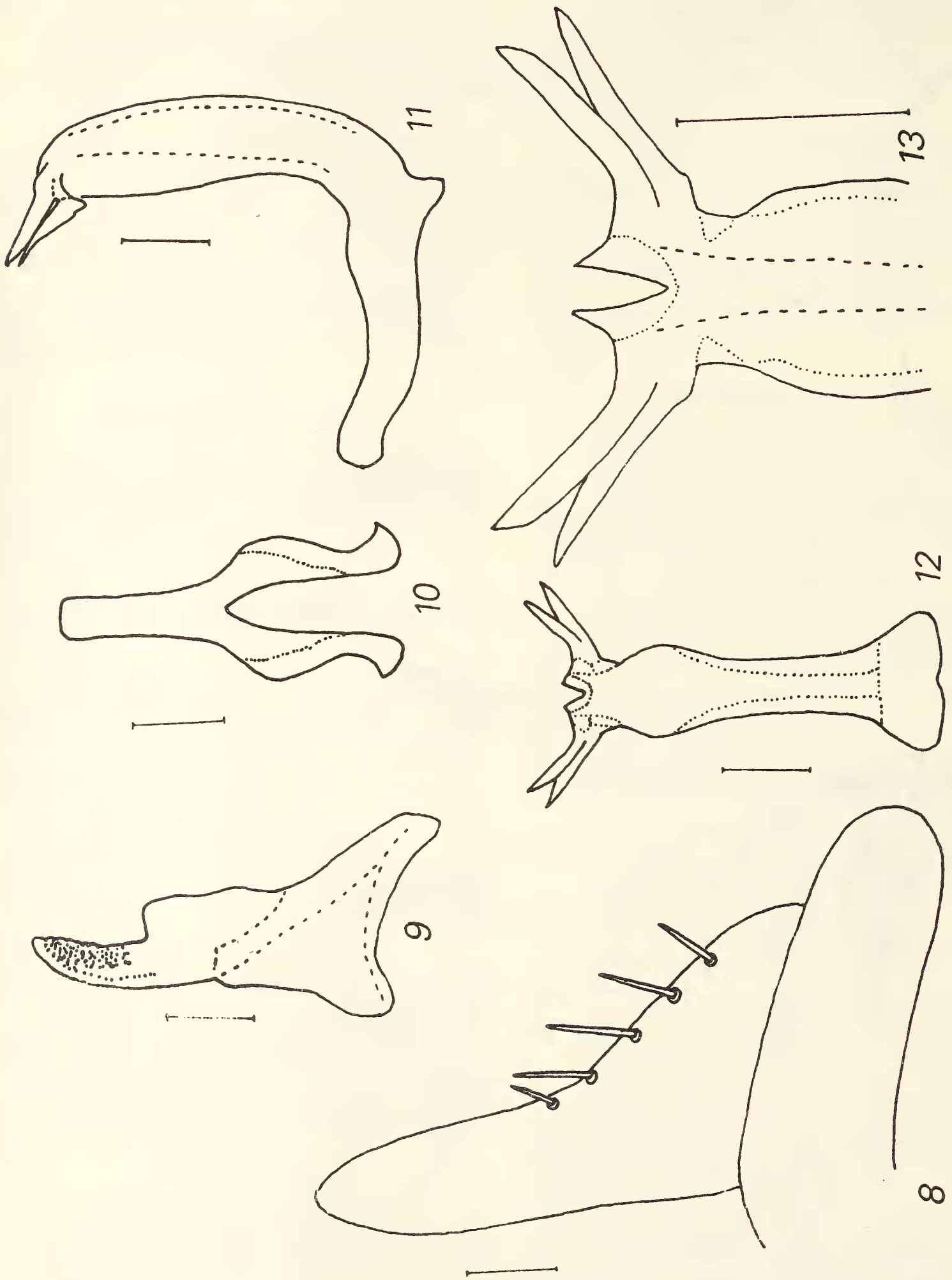
Hecalus porrectus: Morrison, 1973: 421

Material examined: Several specimens from Karnataka: Bangalore, Chincholi, Dharwar, Ilkalgad, Jog Falls, Mudigere; Meghalaya: Shillong; Mizoram: Aizawl; West Bengal: Calcutta.

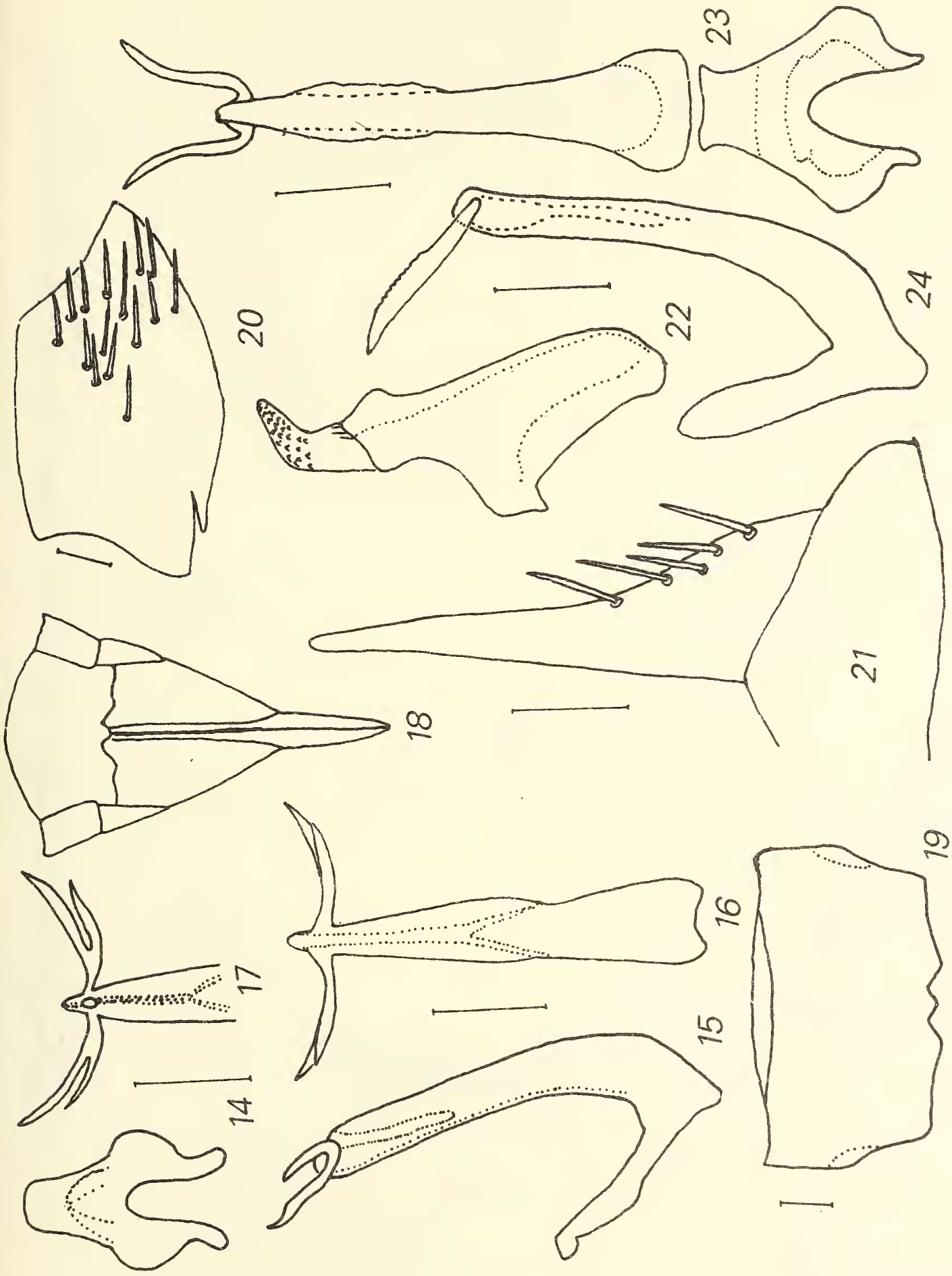
Remarks: It is similar to *H. apicalis* and *H. gressitti* in coloration but can be differentiated by the single pair of apical processes of aedeagus.



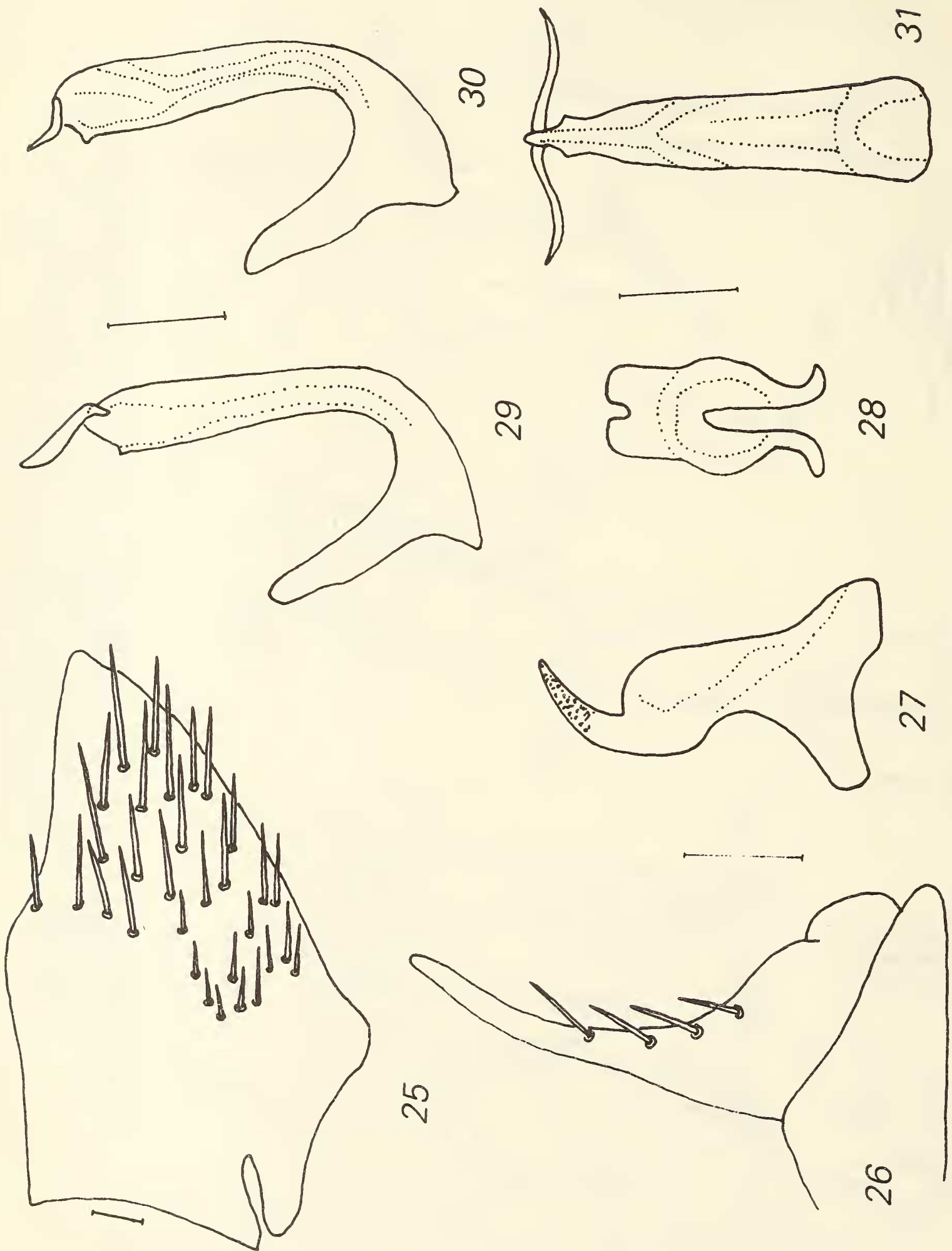
Figs. 1-7. *Glossocratus indicus* sp. nov. 1. Face; 2. Male pygofer; 3. Valve and subgenital plate; 4. Style; 5. Connective; 6. Aedeagus, lateral view; 7. Aedeagus, antero-dorsal view. Scale line = 0.1 mm.



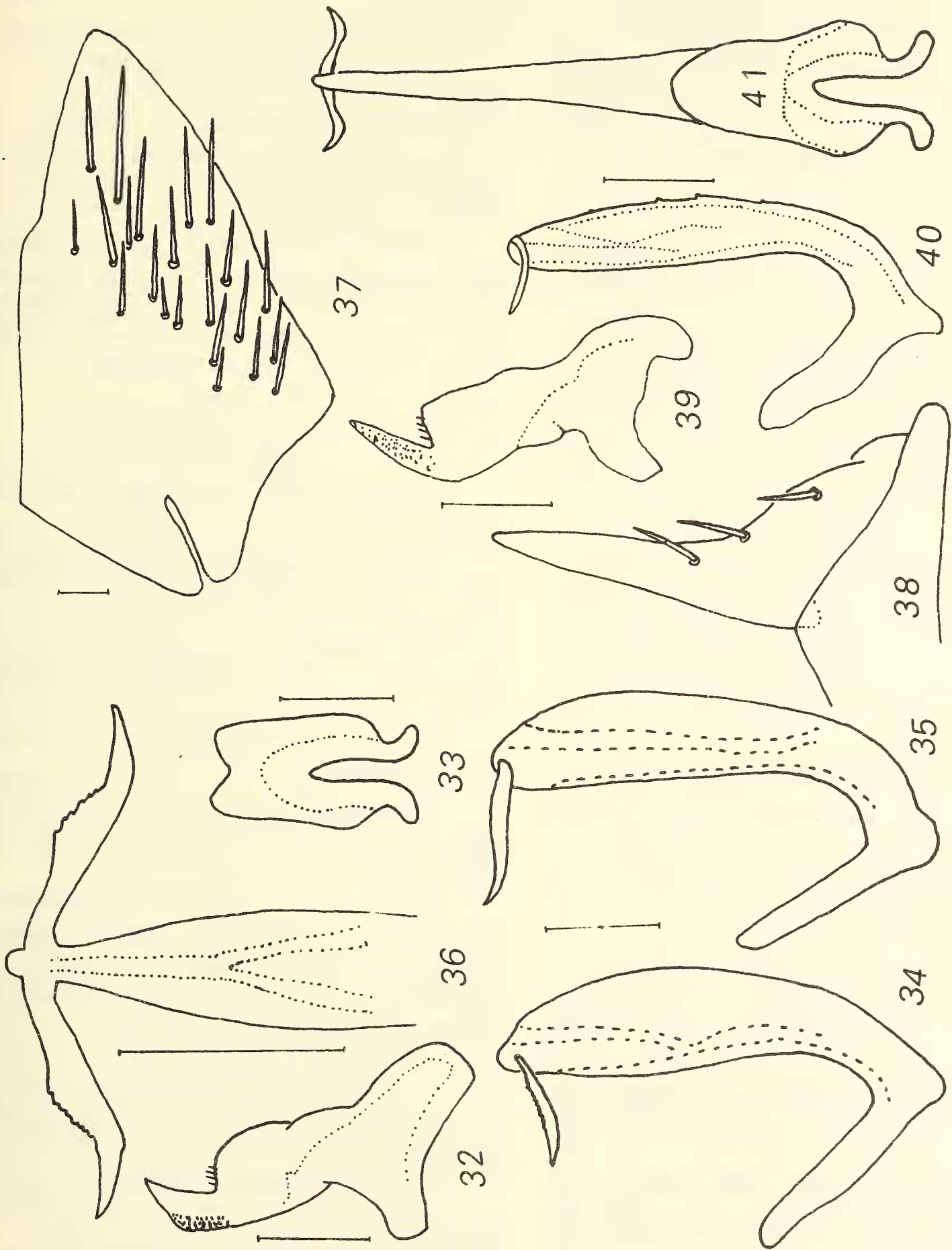
Figs. 8-13. *Glossocratus ramakrishnai* sp. nov. 8. Valve and subgenital plate; 9. Style; 10. Connective; 11. Aedeagus, lateral view; 12. Aedeagus, antero-dorsal view; 13. Apex of aedeagal shaft.



Figs. 14-24. Species of *Hecalus*. 14-17. *Hecalus bifidus* sp. nov. 14. Connective; 15. Aedeagus, lateral view; 16. Aedeagus, antero-dorsal view; 17. Apex of aedeagal shaft. 18-19. *Hecalus lutescens* (Distant) female. 18. Ovipositor; 19. Seventh sternum. 20-24. *Hecalus caudatus* sp. nov. 20. Male pygofer; 21. Valve and subgenital plate; 22. Style; 23. Connective and aedeagus, antero-dorsal view; 24. Aedeagus, lateral view. Scale line = 0.1 mm



Figs. 25-31. *Hecalus tuberculatus* sp. nov. 25. Male pygofer; 26. Valve and subgenital plate; 27. Style; 28. Connective; 29-30. Aedeagus, lateral views; 31. Aedeagus, antero-dorsal view. Scale line = 0.1 mm.



Figs. 32-41. Species of *Hecalus*. 32-36. *Hecalus compressus* sp. nov. 32. Style; 33. Connective; 34-35. Variations in aedeagus, lateral aspect; 36. Apex of aedeagal shaft. 37-41. *Hecalus dentatus* sp. nov. 37. Male pygofer; 38. Valve and subgenital plate; 39. Style; 40. Aedeagus, lateral view; 41. Connective and aedeagus, antero-dorsal view. Scale line = 0.1 mm.

8. *Hecalus lutescens* (Distant)

(Figs. 18-19)

Parabolocratus lutescens Distant, 1918: 31

Hecalus lutescens: Morrison, 1973: 419

Female genitalia: Ovipositor extending beyond pygofer by three times its width. Hind margin of seventh sternum with a short median projection.

Measurements: Male 5.5 mm long, 1.45 mm wide across eyes. Female 5.8 mm long, 1.55 mm wide across eyes.

Material examined: INDIA: Tamil Nadu: 1 male, 2 females, Oothu, 28.x.1975, Coll. C.A. Viraktamath, 2 males, 2 females, Valparai, 13.iv.1981, Coll. A.R.V. Kumar, (UAS).

Remarks: So far this species is known only from the hills of Tamil Nadu. The female is described for the first time here.

9. *Hecalus caudatus* sp. nov.

(Figs. 20-23)

Yellowish green. A black spot at apex of clavus.

Vertex broadly subtriangular, anterior margin slightly upturned, proportion of interocular width to length 48:43 in male, 59:56 in female. Face strongly tumid. Pronotum shorter than vertex, 2.1 and 2.23 times as wide as long in male and female, respectively.

Male genitalia: Aedeagus with well developed dorsal apodeme, shaft with lateral membranous narrow keel visible in antero-dorsal aspect, with a pair of caudodorsally directed processes, each process minutely serrate dorsally.

Female genitalia: Ovipositor extends by a distance equal to 2.5 times its width beyond pygofer. Hind margin of seventh sternum with a median triangular projection.

Measurements: Male 6.5 mm long, 1.7 mm wide across eyes. Female 7.3 mm long, 2.0 mm wide across eyes.

Material examined: Holotype male, INDIA: Karnataka: Bangalore, 916 m, 9.ix.1980, Coll. Maragal, (UAS). Paratypes: 2 females, data as for holotype (NHM, UAS).

Remarks: *H. caudatus* is closely related to *H.*

umballaensis from which it differs in having strongly caudodorsally directed aedeagal processes.

10. *Hecalus morrisoni* Rao and Ramakrishnan

Hecalus morrisoni Rao and Ramakrishnan, 1990: 389

Material examined: INDIA: holotype male, Pusa, Bengal, H.L.D. 26.vii.09, At Light (NPC) Coll. not named; Karnataka: several specimens from Bangalore and Bellary.

Remarks: *H. morrisoni* is closely related to and resembling *H. umballaensis* Distant. Specimens collected at Bangalore have aedeagal shaft of uniform width and serrations of the apical process not so prominent as in those from Delhi.

11. *Hecalus tuberculatus* sp. nov.

(Figs. 24-30)

Yellowish green. Lower edge of anterior margin of head brown.

Vertex subtriangular, proportions of interocular width to length 38:23. Pronotum longer than vertex, 2.1 times as wide as long.

Male genitalia: Aedeagus short, widened apically, with a subapical denticle on dorsal margin, apical process short, caudo-laterally directed.

Measurements: Male 5.3 mm long, 1.5 mm wide across eyes.

Material examined: Holotype male, INDIA: Karnataka: Bangalore, 916 m, 22.x.1991, Coll. P.C. Dash, (UAS).

Remarks: *H. tuberculatus* is related to *H. wallengreni* Stål, but differs in the presence of a prominent tubercle on the dorsal margin of shaft near apex and in the shape of the subgenital plates which strongly taper caudally.

12. *Hecalus wallengreni* Stål

Hecalus wallengreni Stål, 1870: 736; Morrison, 1973: 413

Parabolocratus minutus Bierman, 1910: 63

Parabolocratus taiwanus Matsumura, 1912: 286

Parabolocratus mandlensis Pruthi, 1930: 20

Hecalus gramineus Merino, 1936: 353

Material examined: INDIA: West Bengal: 1 male, Calcutta, 17.iv.1975, Coll. C.A. Viraktamath, (UAS).

13. *Hecalus prasinus* (Matsumura)

Parabolocratus prasinus Matsumura, 1905: 48

Parabolocratus dubiatus Bierman, 1910: 64

Hecalus prasinus: Morrison, 1973: 417

Material examined: Several specimens from Karnataka: Bangalore, Bellary, Dharwar, Jog Falls, Raichur, Nandi Hills; West Bengal: Teesta.

Remarks: Very widely distributed in the Oriental region.

14. *Hecalus compressus* sp. nov.

(Figs. 31-35)

Yellowish green. Both upper and lower edges of anterior rim of vertex brown.

Vertex subtriangular, proportion of interocular width to length 41:31 in male, 52:46 in female. Pronotum shorter than vertex in male but longer in female, 2.16 as wide as long.

Male genitalia: Aedeagal shaft strongly compressed, widest at midlength in lateral aspect, with a pair of leaf-like apical processes with serrated dorsal margin.

Female genitalia: Ovipositor extending by a distance equal to twice its width. Hind margin of seventh sternum with a median triangular projection.

Measurements: Male 5.5 mm long, 1.5 mm wide across eyes. Female 6.5 mm long and 1.9 mm wide across eyes.

Material examined: Holotype male, INDIA: Karnataka: Bangalore, 916 m, 10.ii.1992, Coll. P.C. Dash, ex. grasses (UAS). Paratypes: 1 male, 3 females, data as for holotype; 3 males, data as for holotype but collected at GKVK 2.xi.1992, 1 male, INDIA: Karnataka: Nandi Hills (1467 m), 22.xi.1978, Coll. S. Viraktamath, 1 male, INDIA: Karnataka: Sulikere (near Bangalore), 20.xii.1976, Coll. C.A. Viraktamath.

Other material examined: INDIA: Karnataka: 5 males, 15 km NW Ilkalgad, 19.xii.1974, Coll. Ghorpade, 2 males, 2 females, Halebid-Belur,

11.xi.1978, Coll. C.A. Viraktamath, Delhi: New Delhi, 1968, Coll. H.M. Harris, (UAS).

Remarks: This species is related to *H. ghaurii* Rao and Ramakrishnan but differs in the apex of the aedeagal shaft being much broader than in *ghaurii*.

15. *Hecalus dentatus* sp. nov.

(Figs. 36-41)

Dark fuscous green. Lower edge of anterior rim of head dark brown, lateral areas of face darker. Scutellum with four longitudinal dark brown stripes in a few males.

Vertex subtriangular, anterior margin slightly upturned, proportion of interocular width to length 36:24 in male, 48:35 in female. Pronotum longer than vertex in male but shorter in female, 2.24 and 2.16 times as wide as long in male and female, respectively.

Male genitalia: Aedeagus as in *H. lutescens* but considerably shorter, shaft widened apically in lateral aspect with denticles on ventral margin, apical process directed caudo-laterally.

Female genitalia: Ovipositor exceeding pygofer by a distance equal to its width. Hind margin of seventh sternum with a median triangular projection.

Measurements: Male 4.5 mm long, 1.38 mm wide across eyes. Female 5.5 mm long, and 1.63 mm wide across eyes.

Material examined: Holotype male, INDIA: Karnataka: Koppa, 27.xi.1982, Coll. H.V.A. Murthy, (UAS). Paratypes: 9 males, data as for holotype; 1 female INDIA: Karnataka: Jog Falls, 534 m, 18.xi.1976, Coll. B. Mallik, 1 female, Kogar (36 km W of Jog Falls), 23.ix.1991, Coll. P.C. Dash, ex. grasses (NHM, NPC, UAS).

Remarks: *H. dentatus* is similar to *H. lutescens* and *H. fuscovittatus* Morrison in being dark fuscous green. It shares the minute spines on the aedeagus with *H. lutescens* but has more uniformly curved aedeagal shaft, less prominent lateral laminate process, shorter and differently curved aedeagal processes. It is also smaller than *H. lutescens*.

16. *Hecalus ghourii* Rao and Ramakrishnan

Hecalus ghourii Rao and Ramakrishnan, 1990: 388.

Material examined: INDIA: Delhi: holotype male, "Swept on grass, Delhi, IARI, Oct. 65, R. Menon" "Host: Grasses, Loc. New Delhi, Date. Oct. 1965, Coll. M.G.R. Menon" (NPC). Karnataka: several specimens from Bangalore, Nandi Hills, Raichur (UAS). [collection data quoted from specimen labels]

Remarks: This species, as in the case of *H. compressus*, has a highly compressed aedeagal shaft,

with dorsolateral margin laterally produced into a very narrow laminate process. This species can be recognised by its aedeagal shaft which strongly tapers caudally as seen in lateral aspect.

ACKNOWLEDGEMENT

We are grateful to the Head, Division of Entomology, Indian Agricultural Research Institute, New Delhi for permitting us to study the types of Hecalinae under his care.

REFERENCES

- BIERMANN, C.J.H. (1910): Homopteren aus Niederlandish Ost-Indien. II. Herausgegeben von. D. MacGillavry and K.W. Dammerman. *Leyden Mus. Notes* 33: 1-68.
- CAPCO, S.R. (1959): The Philippine species of *Parabolocratus* (Cicadellidae, Homoptera). *Philippine J. Sci.* 88: 325-334.
- DISTANT, W.L. (1908): Rhynchota. Homoptera and Appendix (Pt.). In Bingham, C.T. (ed.) *The Fauna of British India including Ceylon and Burma*. Vol. 4, xv+501 pp. Taylor and Francis, London.
- DISTANT, W.L. (1918): Rhynchota. Homoptera: Appendix, Heteroptera: Addenda. In Shipley, A.F. and Marshall, G.A.K. (eds) *The Fauna of British India including Ceylon and Burma*. (volume 6, Taylor and Francis, London viii+210..
- EVANS, J.W. (1941): New Australian leafhoppers. *Trans. R. Soc. Australia* 65: 36-41.
- KIRKALDY, G.W. (1900): Notes on some Sinhalese Rhynchota. *Entomologist* 33: 293-295.
- LINNAVUORI, R. (1960): Homoptera: Cicadellidae. *Insects Micronesia* 6: 231-344.
- LINNAVUORI, R. (1975): Revision of the Cicadellidae (Homoptera) of the Ethiopian region III. Deltocephalinae, Hecalini. *Acta zool. Fenn.* 143: 1-37.
- MATSUMURA, S. (1905): *1000 insects of Japan* (In Japanese) 2: 42-70.
- MATSUMURA, S. (1912): Die Acocephalinen und Bythoscopinen Japans. *J. Sapporo Coll. Agri.* 4: 279-325.
- MERINO, G. (1936): Philippine Cicadellidae (Homoptera). *Philippine J. Sci.* 61: 307-400.
- MORRISON, W.P. (1973): A revision of the Hecalinae (Homoptera: Cicadellidae) of the Oriental region. *Pacific Ins.* 15: 379-438.
- MOTSCHULSKY, V.I. DE (1859): Homopteres. In *Insectes des Indes Orientales de Contrées Analogues. Étud. Entomol.* 8: 25-118.
- PRUTHI, H.S. (1930): Studies on Indian Jassidae (Homoptera). Part I. Introduction and description of some new genera and species. *Mem. Indian Mus.* 11: 1-68.
- RAO, V.R.S. AND RAMAKRISHNAN, U. (1990): The Indian species of *Hecalus* with descriptions of three new species (Homoptera: Cicadellidae) *Oriental Ins.* 24: 385-397.
- RAO, K.R. (1973): Studies on a small collection of Jassids from Poona (Homoptera: Cicadellidae) *Zool. Anz. Leipzig*, 191: 93-98.
- RAO, K.R. (1989): Description of some new leafhoppers (Homoptera: Cicadellidae) with notes on some synonymies and imperfectly known species from India. *Hexapoda* 1: 57-84.
- RAO, K.R. (1990): Studies on a small collection of leafhoppers (Homoptera: Cicadellidae) from Khasi Hills, Meghalaya. *Rec. Zool. Survey India Occ. Pap. No. 127*: 1-123.
- STÅL, C. (1870): Hemiptera Insularum Philippinarum. Bidrag till Philippinska Öarnes Hemipter-fauna. *Svenska Vetensk.-Akad. Öfv. Förh.* 27: 607-776.
- VIRAKTAMATH, C.A. (1976): New species of *Doratulina* and *Bumizana* (Homoptera: Cicadellidae) from Karnataka. *Oriental Ins.* 10: 76-86.
- VIRAKTAMATH, C.A. AND VIRAKTAMATH, S. (1989): New species of *Bumizana* Dist. and *Chloropelix* Lindb. from Indian subcontinent (Insecta, Homoptera, Auchenorrhyncha: Cicadellidae). *Reichenbachia* 27: 19-26.
- WALKER, F. (1858): Supplement. List of the specimens of Homopterous insects in the collection of the British Museum. 307 pp.

REVIEWS

1. APPLIED ETHNOBOTANY - A CASE STUDY AMONG THE KHARIAS OF CENTRAL INDIA, by E. Varghese, S.V. D. Deep Publication. New Delhi-110063. pp i-xix + 1-307 (21 x 13.5 cm). Price Rs. 400.00 or \$ 70.00

Ethnobotany is the study of human interaction with plants in a given environment. Ethnology is defined as the comprehensive study and analysis of non-literate people or aboriginal tribes of a particular region. Ethnobotanic studies concentrate on the areas inhabited by aboriginals or tribals of rural areas and their dependence on the plant wealth of their surroundings.

Effort is being made here to evaluate the work carried out by Rev. Fr. E. Varghese on the ethnobotany among the Kharias of Central India. Ethnobotany is closely related to Economic Botany, but the difference is that Ethnobotany is the applied botany known to restricted tribes and has limited utility among them.

Although Ethnobotany is as old as human history, growing ecological and environmental awareness has given a boost to this neglected branch of Science. According to Rev. Fr. Varghese, it is in the past one century or so that Ethnobotany has begun to emerge as an independent discipline. In India it is more than 4000 years old. It is believed that 'Atharvaveda' which also deals with 'Ayurveda' or the science of vegetable products useful in health care was well known from 2000 B.C. Information about these plant remedies was known to people and practitioners of Ayurveda and passed on from 'gurus' to 'sishtyas' by word of mouth. It is only in the recent past that the knowledge of our ancient Vedas has been written down in the form of manuscripts and books. The major difference in vedic information and ethnobotanic information is that the former has remained alive and stood the test of time.

Data gathered by Fr. Varghese will be tested by the scientific community in future and the utility or otherwise of the information gathered will be ascertained. At present, the attempts of the author have been restricted to collecting reliable information and confirming it from as many people as possible in the same tribal community.

Fr. Varghese has rightly pointed out that ethnobotanical endeavours are known in India right from the time of the Vedas and Samhitas. Rigveda, the oldest available record dating back to 4000-5000 B.C. recounts some medicinal plants. Atharvaveda which contains 'Ayurveda', gives us information about 2000 plants and their medicinal properties. The Ayurvedic medicinal plants are described in the three following ancient texts:

1. Charaka samhita.
2. Sushruta samhita.
3. Ashtanga hridaya.

These three texts contain information on 700 species of plants, their properties, and methods of formulating drugs from them for treatment. Presently about 35,000 species of crude medicinal plants are used in practice.

According to Rev. Fr. Varghese, the term Ethnobotany, which was introduced by J.W. Harshberger in 1895, has been in use for 100 years.

Traditional medicine is known in Indian literature from the middle of the 16th century. Garcia D'orta - a Portuguese physician in Goa wrote the first book on medicinal plants in India COLOQUIAS DAS SIMPLES E DROGAS DA INDIA, or the Dialogue on Indian Medicinal Plants. It describes well known medicinal plants in India, especially in Goa and other areas.

Another reputed early work in India is Drakestein van Rheede's HORTUS MALABARICUS (1678-1703). This 12 volume work was prepared by a Dutch Administrator of Malabar region. It describes about 800 species of flowering plants. Over 600 species in this work have been provided binomials by Carl Linnaeus, in his famous work SPECIES PLANTARUM (1753).

The names of plants used in these 12 volumes are generally coined from their utilities and habitats etc. A few names are given to illustrate the origin of their local names, which is one of the points made by Fr. Varghese in his book:

1. Adalodekam - Adal = Internal,
- Odecam = curing medicine.
= *Adhatoda zeylanica* Medicus
- *Justicia adhatoda* Linn.
2. Karakanjivam - Kara - Terrestrial (-herbaceous).
Kanjivam = Bitter leaved.
= *Andrographis paniculata* (Burm.f.)
Wall ex Nees
= *Justicia paniculata* Burm.f.
3. Vayalschulli - Vayal = Paddy fields.
Schulli = spiny herb.
= *Hygrophila schulli* (Ham.) Almeida &
Almeida.
= *H. auriculata* (K. Schum.) Heine

If we take for granted that Ethnobotany is the knowledge of a particular tribal group which is carried out for centuries within the tribe, then it is strange to find the inclusion of species like *Chromolaena odorata* (L.) King. & Robin (Syn. *Eupatorium odoratum* L.) (West Indian species, introduced in India - (Clarke, Comp. Ind. 30, 1878) and *Evolvulus nummularius* (L.) L. - a recently

introduced weed found in Indian gardens.

However, this type of information is not found only in the present book. We encounter names like Sitaphal (*Annona squamosa* L.) and Ramphal (*Annona reticulata* L.) of plants which have come to India only after the discovery of the new world (America), which are believed to have been introduced by the Portuguese.

The history of Ethnobotanical works in India will not be complete if we do not give appropriate credit to the following works:

1. John Fleming (1810) - A CATALOGUE OF INDIAN MEDICINAL PLANTS AND DRUGS.
2. Ainshie (1812) - MATERIA MEDICA OF HINDUSTAN.
3. Chopra, R.N. (1933). - INDIGENOUS DRUGS OF INDIA.
4. George Watt (1896) - Dictionary of Economic Products of India.

This volume on Applied Ethnobotany of Kharias of Central India speaks for Rev. Fr. Varghese's capability and we, his friends and colleagues are proud of his achievements.

Indeed, Fr. Varghese has done pioneering work among the Kharias of Central India.

M.R. ALMEIDA

2. DIRECTORY OF NATIONAL PARKS AND SANCTUARIES IN INDIA MANAGEMENT STATUS AND PROFILES. Edited by Ranjit Lal, Ashish Kothari, Pratibha Pande, Shekhar Shah pp. 231 (19 x 24.5 cm) with maps and many illustrations in black and white. New Delhi 1994. Sponsored by Wildlife Institute of India, Dehradun and Centre for Public Policy, Planning and Environmental Studies, Indian Institute of Public Administration, New Delhi. Hardback Rs. 350, \$ 30; paperback Rs. 200, \$ 20.

The Directory, third in a series of volumes covering national parks and sanctuaries in India, elaborates on the management status and profiles of five national parks and nineteen sanctuaries in Karnataka. These directories are the result of the ongoing study on the management of national parks and protected areas in India. It is a good and timely attempt at building up a reliable and exhaustive database with maps on the National Parks and Sanctuaries of Karnataka. The attempt will definitely help in understanding and cataloguing

the state's diverse ecosystems within the boundaries of its protected areas and the developmental pressures facing them.

The directory is a well coordinated exercise at collecting, collating and disseminating information on all the Protected Areas of the State of Karnataka under one cover. The information on various aspects of the management of National parks and Sanctuaries of Karnataka will prove beneficial to researchers, wildlife managers, policy makers and laymen alike.

The directory also contains an inventory of the floral and faunal components of the protected areas, though it is not as exhaustive as expected, especially the list of birds recorded in the areas covered. The list of endangered floral and faunal species is informative.

The format containing the information on the land use pattern in and around the protected areas, is well laid out and covers all aspects which might interest policy makers and laymen alike. Though many gaps remain in the current information, it is hoped that its widespread use will encourage both managers of the protected areas and the researchers to pool their knowledge to enhance the effectiveness of the directory.

Though the directory contains proposals for improving the wildlife protected area network in Karnataka, it does not mention the urgent need for

increasing the manpower and material resources of the enforcement agencies, viz. the Forest department and its Wildlife wing. The understaffed and underequipped department appears to be fighting a losing battle in most areas.

The book is a must for all conservation oriented institutions and individuals. It must also form a part of the District administration's libraries across the state.

As rightly hoped by the authors, the directory will prove to be a catalyst in our efforts towards saving the state's and the country's wilderness areas from destruction. The only hope lies in planning sustainable use of the fast depleting natural resources on hand, of which the directory is a good benchmark.

S. ASAD AKHTAR

3. ANATOMY AND HISTOLOGY OF THE COMMON HOUSE SHREW By R. V. Ranade, University of Poona, Price Rs. 100/-

The book is a monograph based on the thesis, "Anatomical and histological studies on the house shrew, *Suncus murinus blanfordi* (Anderson)" that was submitted by the author to the University of Poona for the degree of Doctor of Philosophy.

The monograph has a good representation of anatomical and histological plates with relevant descriptions. The line drawings are neat and proportionate. Histological preparations are printed in black and white. As a result the clarity of the

staining effects has been lost in certain cases.

A bibliographical list of references would be useful for researchers taking up further study on *Suncus*.

As such the book will have limited circulation and will be more useful to the departments and libraries where work on smaller mammals is undertaken.

A.M. BHAGWAT